Practical Breeding Program Issues – Beef Industry

Kath Donoghue

Scientist

Animal Genetics and Breeding Unit

UNE The University of NEW ENGLAND

MEAT & LIVESTOCK AUSTRALIA

NSW DEPARTMENT OF PRIMARY INDUSTRIES

Overview of presentation

1. Structure of beef industry

- Some characteristics
- Role of different sectors (seedstock; cow-calf; grower/finisher; end-user)

2. Genetic improvement in the beef industry

- Defining breeding objectives
- Utilising available tools (eg EBVs; $Indexes; gene markers)
- Breeding design (eg crossbreeding)

3. Future developments

Structure of the industry

Some characteristics of the beef industry:

- Many herds
- Many geographic locations
- Many breeds
- Regular inflow of genetics from outside herd

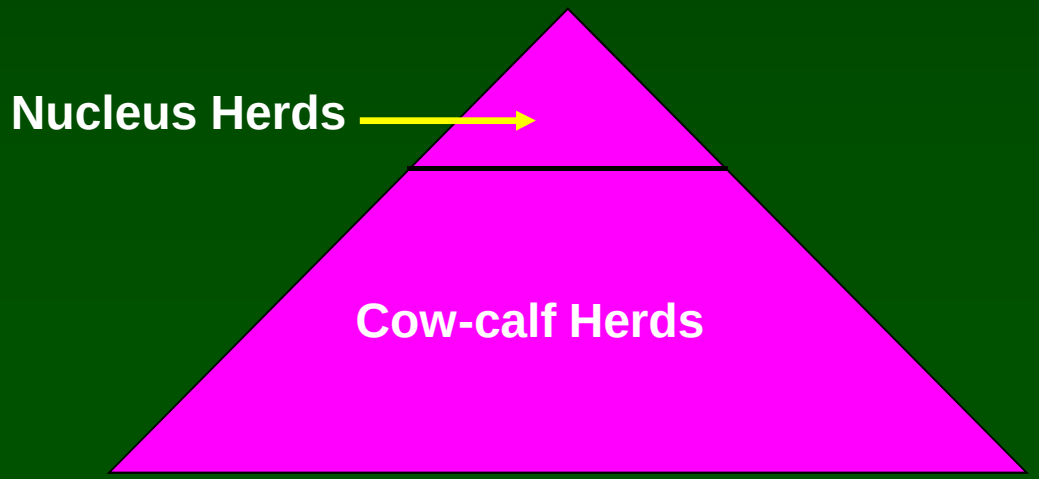
Impact amount & rate of genetic progress

Structure of the industry

Beef industry consists of four general sectors:

- Seedstock sector
- Cow-calf sector
- Grower/finisher sector
- End-user (processor sector)

Only seedstock & cow-calf sectors involved in genetic improvement



Seedstock sector

Core of genetic improvement:

- Create & supply superior genetics
- Foundation of genetic evaluation system (BREEDPLAN)
- Direction of breeding program for whole industry
- Communication

Use of artificial insemination (AI):

- Differs across breeds (eg Angus 42%; Hereford 19%)
- Much lower than dairy industry

Cow-calf sector

Main roles in genetic improvement:

- Identify & obtain superior genetics
- Implement effective mating program
- Market product to sectors further down supply chain
- Provide feedback to seedstock sector

Use of artificial insemination (AI):

- Less than 5% of herds
- Big opportunities in future

Grower/finisher sector

Grower/finisher:

- Value-added product
- **Buy** in animals to grow-out/finish (fatten) & sell
- Provide feedback to cow-calf (& seedstock) sectors

Not actively involved in genetic improvement but.....

- Benefit from superior genetics
- Need to be aware of genetic information available

End-user sector

End-users:

- Feedlots, processors
- Little use of genetic information in past
- Unwillingness to pay premium for superior genetics???
- Provide critical feedback to **ALL** sectors

Not actively involved in genetic improvement but.....

- Benefit from superior genetics
- Need to be aware of genetic information available

Key components of genetic improvement

1) **Breeding objective**
   - Determine goal of breeding program

2) **Genetic evaluation**
   - Describe genetic merit of selection candidates

3) **Breeding program design**
   - Make selection and mating decisions
   - Use all available tools (eg crossbreeding, AI, ET)

Defining breeding objectives

Critical component of genetic improvement:

- Determines genetic merit of future generations in **all** sectors

Breeding objective considerations should include:

- Production system of (commercial/grower/end-user) clients
- Traits of economic importance in client's production system

BreedObject:

- Tool to assist in formalising breeding objectives
- Available on the internet (http://www.breedobject.com)

Breeding objectives should be revised on a regular basis!

Utilisation of available tools

Descriptors of genetic merit:

- EBVs (BREEDPLAN)
- $Indexes (BreedObject)
- Gene marker tests (GeneSTAR® marbling, tenderness & feed efficiency)

Reproductive tools:

- Embryo transfer (ET)
- Artificial insemination (AI)

BREEDPLAN

- Modern beef cattle genetic evaluation system
- flexible and evolving system
- genetic comparisons across herds, years
- within breed (now some multi-breed tables)
- 20 Aust. breeds + several overseas clients
- produces Estimated Breeding Values (EBV)
  - *tool to assist breeding of more profitable cattle*

BREEDPLAN Analysis

- performance records

  e.g. weights, scans, carcass, joining records

- complete management data
- pedigree information
- Best Linear Unbiased Prediction (BLUP)
- one system (breed specific input files)

BREEDPLAN Model

- animal model with full pedigree
- multiple trait (all together)
  - 5 growth (+ maternal for BW, WWT)
  - 10 carcase (scans and abattoir)
  - 4 fertility
- Heritabilities and correlations (both + & -)
  - don't need to know ….. all an animal's EBVs
  - but important to measure all traits
    - find "curve benders" and allow selection for balance

BREEDPLAN Models (cont.)

- genetic groups (base animals)
  - time, overseas, and breeds
- statistical enhancements – SxH , HV
- incorporate overseas EPDs

  (currently under review to increase OZ emphasis)
- additional threshold model
  - calving ease (with BWT and GL)
  - temperament scores

Traits in BREEDPLAN

growth	*carcass*	*reproduction*

Traits in BREEDPLAN

growth	*carcase*	*reproduction*
birth wt	scan rib fat	gestation length
weaning wt	scan P8 fat	scrotal size
yearling wt	scan EMA	days to calving
final wt	scan IMF%	calving ease
mature cow wt	carcase wt	- direct
	carcase EMA	- daughters
	carcase rib fat	
net feed intake	carcase P8 fat	temperament
	retail yield %	
	IMF% (marbling)	

Hereford Animal Details

COURALLIE WALLABY (AI)

Identifier: HH1W013
Sex: Male
Tattoo: W013
Birth Date: 17/03/2001
Calving Year: 2001
Reg. Status: Registered
Status: Active
Sire: HH ADVANCE 885H (IMP)
Dam: COURALLIE DAFFODIL T170 (AI)
Breeder COURALLIE HEREFORDS
Current Owner: DONOGHUE PAST CO
Society: AHS
Horn: Horned
Progeny: [View All] [View by Herd]
Pedigree: [View]

2005 AUTUMN GROUP BREEDPLAN EBVS

	Calv. Ease Direct (%)	Birth Wt. (kg)	200 Day Wt. (kg)	400 Day Wt. (kg)	600 Day Wt. (kg)	Mat. Cow Wt. (kg)	Milk (kg)	Scrotal Size (cm)	Carcase Wt. (kg)	Eye Muscle Area (sq.cm)	Rib Fat (mm)	Rump Fat (mm)	Retail Beef Yield (%)	IMF %
EBV	-3.8	+6.0	+30	+38	+62	+63	+15	+1.4	+32	+2.8	+0.5	+0.6	+0.7	+0.2
Acc	46%	79%	72%	69%	67%	52%	44%	75%	56%	43%	53%	53%	50%	46%
Breed Avg. EBVs for 2003 Born Calves (Click for Percentiles)														
EBV	-0.7	+4.1	+21	+34	+49	+49	+8	+0.9	+28	+1.8	+0.2	+0.2	+0.4	0.0

Traits Observed: 200WT, 400WT, SS, FAT, EMA, IMF

Statistics: Number of Herds: **2**, Progeny Analysed: **17**, Scan Progeny: **0**, Carcase Progeny: **0**, Number of Dtrs: **0**

Show Index Values

AGBU

MEAT & LIVESTOCK AUSTRALIA

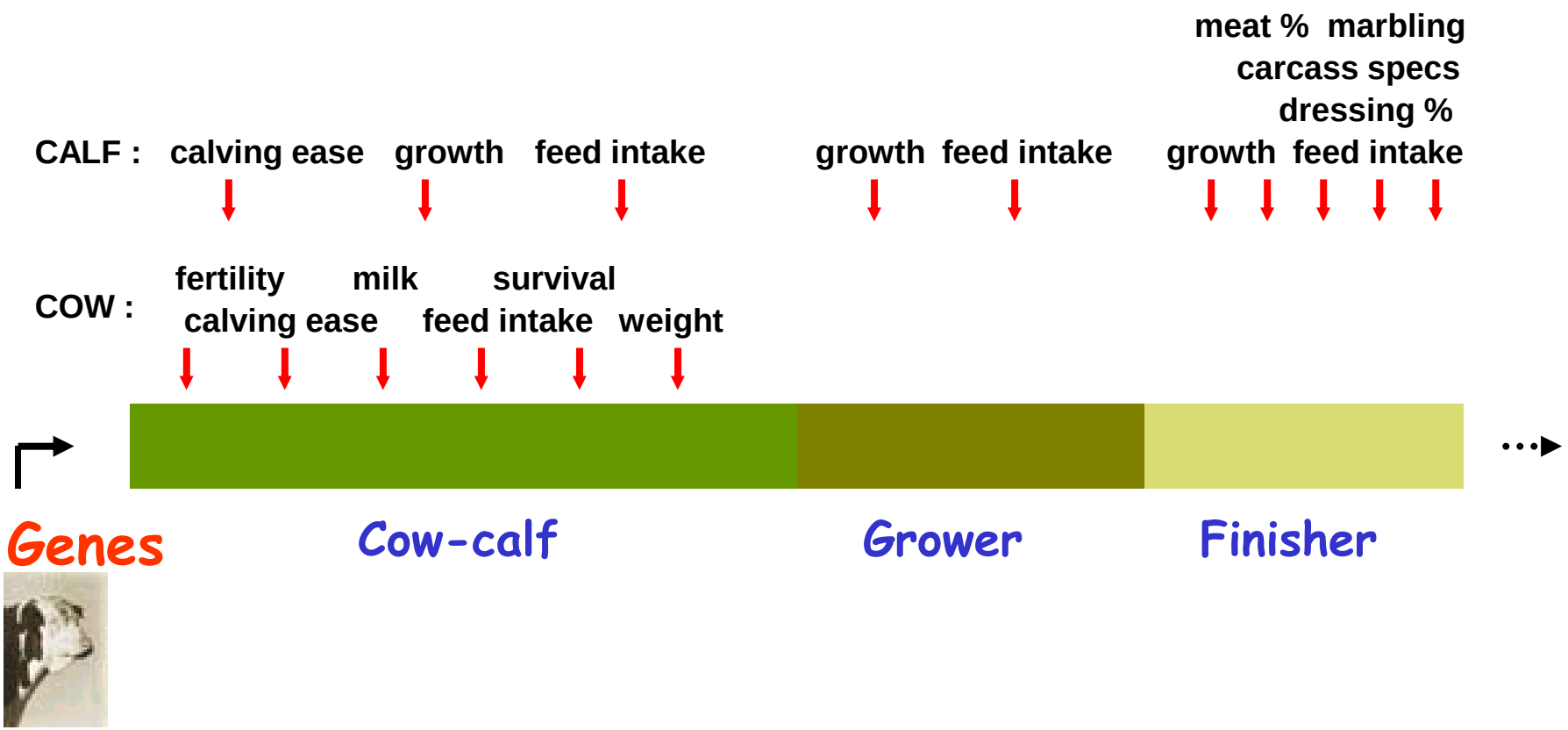
NSW DEPARTMENT OF PRIMARY INDUSTRIES

BreedObject

Breeding objective & indexing software for the beef industry

Profit focus for breeding

whole **commercial market production system**
- cow herd to slaughter



Profit Drivers

COW

calving ease

weaning rate

milk

survival rate

liveweight

feed intake

YOUNG ANIMAL

calving ease

sale liveweight

feed intake

dressing %

carcase meat %

carcase fat depth

carcase marbling

economic values

for the commercial production use targeted, over a planning horizon, & with discounting to present value

For change in a profit driver, assess:

change in returns

change in costs

change in feed cost

---

economic value

($ / trait unit)

For other profit drivers unchanged

Factors that can affect the importance of the profit drivers ...

from one breeder or herd to another

breeding role

market

country

cow herd

management

view of future

Breeding-market-production system targeted

Calculating the value of the profit drivers ...

Intended use of bulls (genes)

Case details

HERD MODEL
(with retained ownership)

$ value of changing each profit driver
(with others unchanged)

Example: **Hereford Supermarket**

$ per unit

These are your:	Economic Values
Sale Liveweight Dir.	0.583 $/Kg
Sale Liveweight Mat.	0.410 $/Kg
Dressing %	5.504 $/%
Saleable Meat %	4.428 $/%
Fat Depth (rump)	5.531 $/MM
Cow Weaning Rate	0.976 $/%
Marbling Score	0.000 $/scor
Cow Survival Rate	2.697 $/%
Cow Weight	-0.176 $/Kg
Calving Ease - dir.	1.800 $/%
Calving Ease - mat.	0.735 $/%

genetic variation

Profit Drivers	Genetic Std. Dev.
Sale Liveweight Dir.	19.6 kg
Sale Liveweight Mat.	8.8 kg
Dressing %	1.0 %
Saleable Meat %	1.5 %
Fat Depth (rump)	1.3 mm
Cow Weaning Rate	9.7 %
Marbling Score	n.a.
Cow Survival Rate	1.7 %
Cow Weight	31.3 kg
Calving Ease - dir.	7.9 %
Calving Ease - mat.	7.9 %

% importance - how calculated

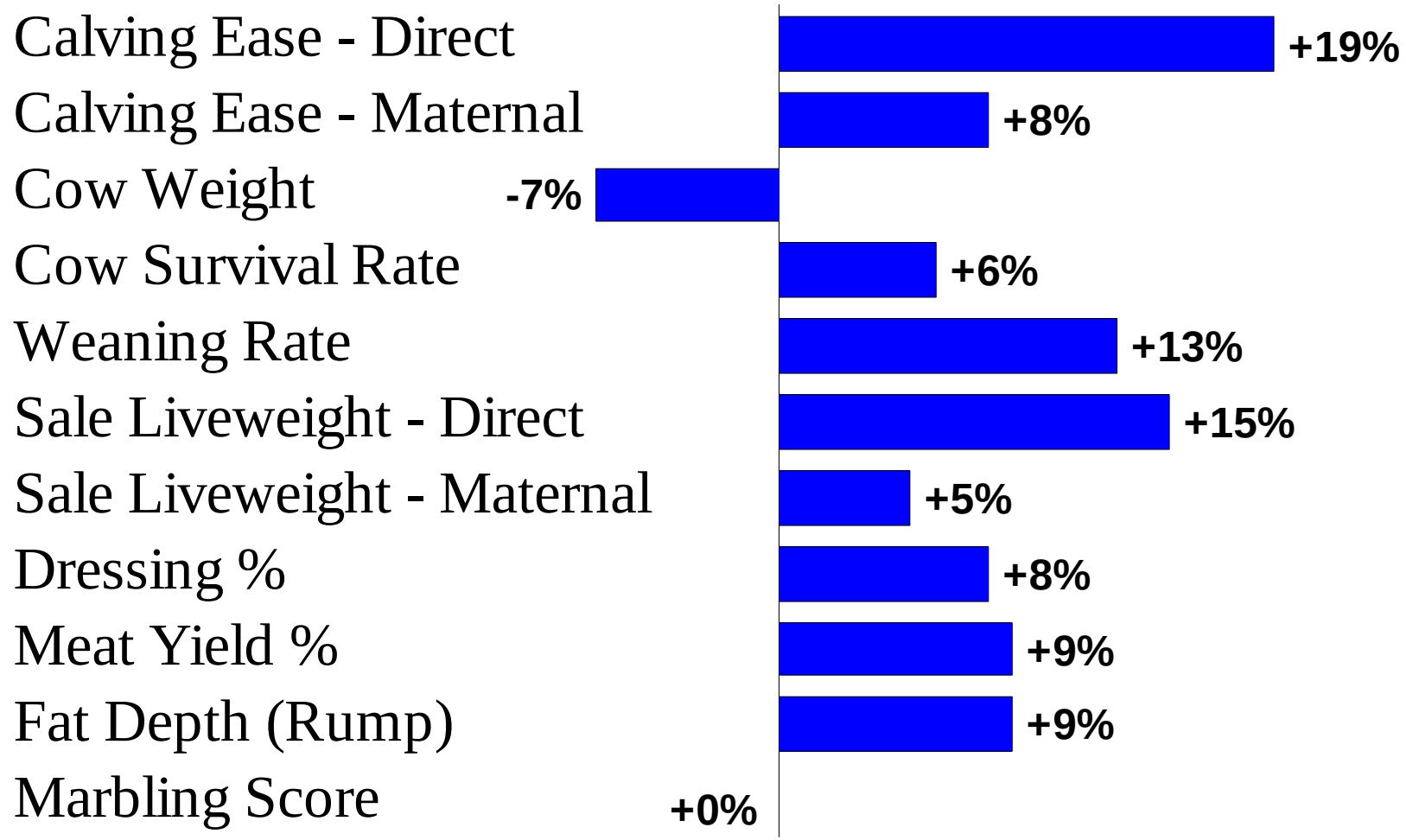
REV = economic value x Genetic Std. Dev.

Profit drivers	REV (relative econ. value)	% Profit driver importance
Sale Liveweight Dir.	11.4 $	15 %
Sale Liveweight Mat.	3.6 $	5 %
Dressing %	5.7 $	8 %
Saleable Meat %	6.6 $	9 %
Fat Depth (rump)	7.0 $	9 %
Cow Weaning Rate	9.5 $	13 %
Marbling Score	0.0 $	0 %
Cow Survival Rate	4.6 $	6 %
Cow Weight	-5.5 $	-7 %
Calving Ease - dir.	14.3 $	19 %
Calving Ease - mat.	5.8 $	8 %

$\lvert\Sigma\rvert$ =	74.0	

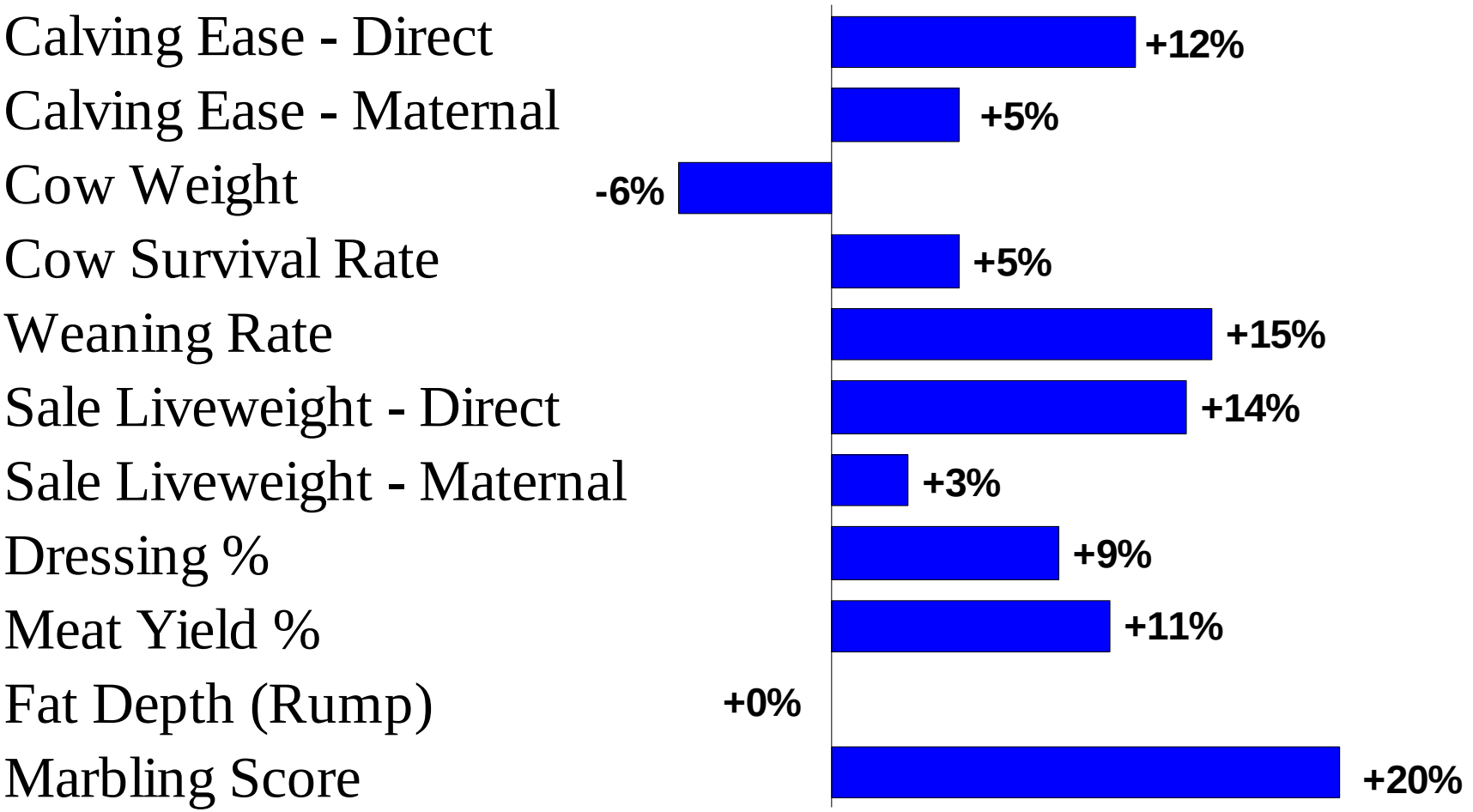
Importance of the profit drivers

Example: ***Supermarket***



Importance of the profit drivers

Example: Angus 'B3'



AGBU

About $Indexes ...

'an EBV that's targeted at the underlying market production system profit drivers'

- ***overall*** **EBV, for economic merit (profit)**
- **use in both stud & commercial selection**
- **based on 'BreedObject' technology**

$Index process

Intended use of bulls (genes)

$ Importance of PROFIT DRIVERS

(economics & genetics)

trait genetic r'ships

… … … EBVs … … …

(genetics & trait genetic r'ships)

(numerous)

$Index

From profit drivers to EBV emphases ...

$ values of the profit drivers

genetic r'ships with EBVs

$ value emphasis for each EBV

Example: Supermarket

$ per unit

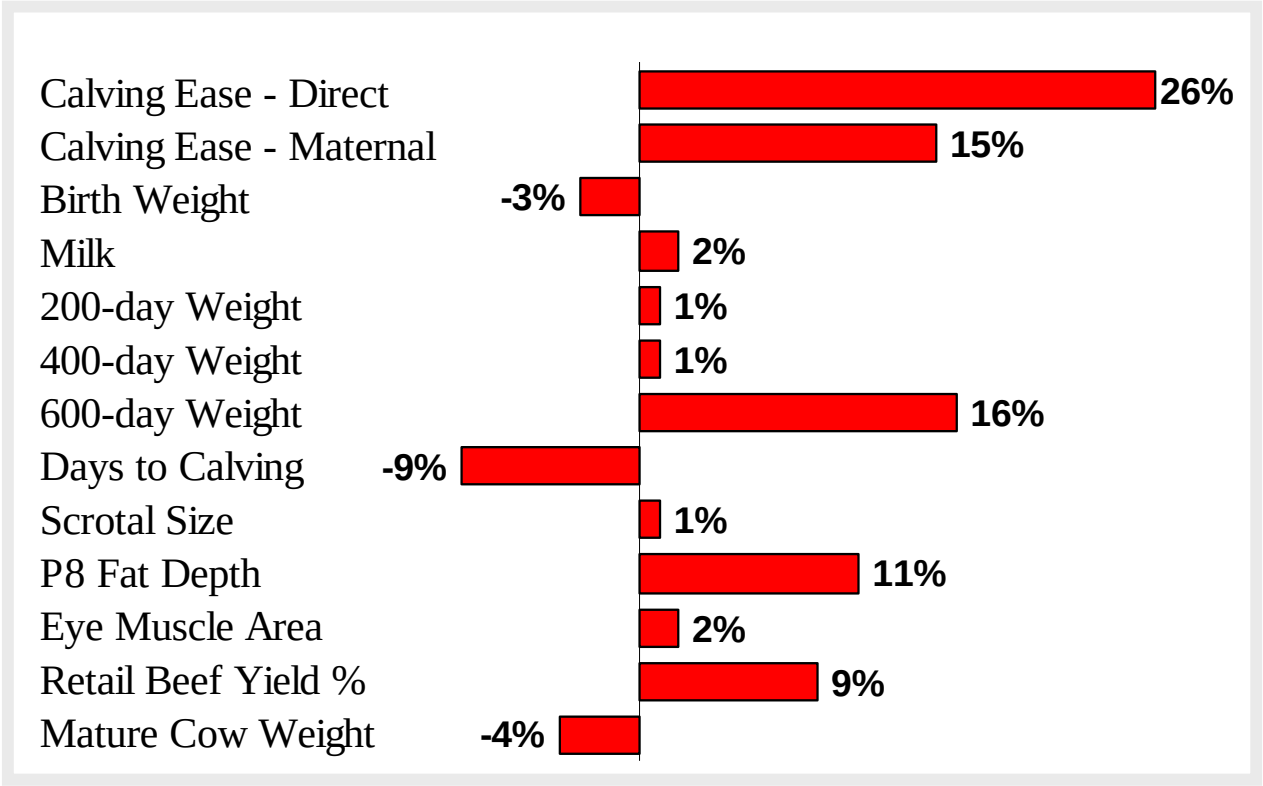
E B V	Index Weighting
Calving Ease - dir.	[2.079]
Calving Ease - mat.	[1.191]
Birth Weight-direct	[-0.662]
200-day Milk	[0.157]
200-day Growth	[0.067]
400-day Weight	[0.047]
600-day Weight	[0.467]
Days to Calving	[-0.893]
Scrotal Size	[0.234]
Carc. Fat Depth	[3.074]
Carc. Eye Muscle Area	[0.589]
Carc. Retail Beef Yld%	[3.451]
Mature Cow Weight	[-0.066]

multiply & sum to give $Index value

and for illustration purposes

$ per unit → **$ per standard amount of units**

(& expressed as %)



2005 AUTUMN GROUP BREEDPLAN EBVS

	Calv. Ease Direct (%)	Calv. Ease Dtrs (%)	Gest. Len. (days)	Birth Wt. (kg)	200 Day Wt. (kg)	400 Day Wt. (kg)	600 Day Wt. (kg)	Mat. Cow Wt. (kg)	Milk (kg)	Scrotal Size (cm)	Days to Calv.	Carcase Wt. (kg)	Eye Muscle Area (sq.cm)	Rib Fat (mm)	Rump Fat (mm)	Retail Beef Yield (%)	IMF %	Net Feed Intake (kg/day)
EBV	-3.9	-2.8	**-1.8**	+3.4	+31	**+59**	**+77**	+58	**+18**	**+1.7**	-3.1	+55	+4.7	-0.6	-0.6	**+2.4**	-0.4	-0.13
Acc	84%	72%	96%	97%	97%	97%	96%	92%	93%	92%	56%	91%	79%	89%	89%	87%	83%	59%
Breed Avg. EBVs for 2003 Born Calves(Click for Percentiles)																		
EBV	-0.7	+0.1	-0.1	+4.1	+21	+34	+49	+49	+8	+0.9	-0.9	+28	+1.8	+0.2	+0.2	+0.4	0.0	+0.04

Statistics: Number of Herds: **40**, Progeny Analysed: **350**, Scan Progeny: **141**, Carcase Progeny: **0**, Number of Dtrs: **96**

Hide Index Values

SELECTION INDEX VALUES

Market Target	Index Value	Breed Average
Supermarket	+$42	+$22
Hereford Prime	+$42	+$21
Short Fed (100-150 Days)	+$45	+$20
Long Fed Export	+$45	+$22
E U Index	+$54	+$26
$Index Descriptions (Click Here)		

Email worldgenetics@optusnet.com.au

Homepage www.pollhereford.com.au

WORLD GENETICS

Sale Notes

EBVs explained

POLL HEREFORD GROUP BREEDPLAN

$Indexes widely available ...

Australia

- Angus
- Brahman
- Charolais
- Heref. & Poll Heref.
- Limousin
- Murray Grey
- Santa Gertrudis
- Shorthorn
- Simmental
- AACo Composite

Argentina

- Argentine Angus

New Zealand

- NZ Angus
- NZ Hereford

United Kingdom

- UK Angus
- UK Belgian Blue
- UK Simmental
- UK South Devon

Gene markers

Several tests currently available:

- GeneSTAR® marbling, tenderness & feed efficiency
- Igenity TenderGENE™

Reported separately to other descriptions of genetic merit

- Mainly used as marketing tool to date

Likely that more tests will become available

- Imperative that marker information is incorporated into EBVs

Angus Animal Details BALD BLAIR HIGHMARK Z58 (AI) (TNC) - Windows Internet Explorer

http://abri.une.edu.au/online/cgi-bin/i4.dll?1=22342A3D&2=232F5F&3=56&5=2B3C2B3C3A&6=5D5A5B24242627202E&9=52505C5D

Angus Animal Details BALD BLAIR HIGHMARK Z58 (AI)...

EBVs Disclaimer

Angus Animal Details

BALD BLAIR HIGHMARK Z58 (AI) (TNC)

First Previous Next Last

Identifier:	NBBZ58
Sex:	Male
Tattoo:	BB Z58 (T) (Both Ears)
Birth Date:	20/07/2004
Calving Year:	2004
Status:	Active
Registration Status:	HBR
Colour:	Tested non-carrier
GeneStar® Marbling:	Tested Marbling (M1-0, M2-1) Total of 1 favourable form of the genes.
GeneStar® Tenderness:	Tested Tenderness (T1-2, T2-2) Total of 4 favourable forms of the genes.
	Gene Marker Results Explained
Sire:	GARDENS HIGHMARK
Dam:	BALD BLAIR W4 (AI)
Breeder:	BALD BLAIR PASTORAL CO
Current Owner:	BALD BLAIR PASTORAL CO
DNA #:	6642807
Progeny:	[View All] [View by Herd]
Pedigree:	[View]
EBV Graph:	[View]

BALD BLAIR ANGUS

View Larger Image: 114.3kb

* Semen Available *

Export Semen PT & YSP

Angus Young Sire Program 2006

Done

Local intranet

100%

start

Angus Animal Details ...

EN

5:32 PM

Gene Marker Results

Gene Marker results are displayed on the web in two parts - a gene marker code and a test result.

1. Gene marker code

- **M1-** GeneStar Marbling 1
- **M2-** GeneStar Marbling 2
- **M3-** GeneStar Marbling 3
- **T1-** GeneStar Tenderness 1
- **T2-** GeneStar Tenderness 2
- **T3-** GeneStar Tenderness 3
- **T4-** GeneStar Tenderness 4

2. Test result

- **0** indicates the animal carries zero copies of the favourable form of the gene.
- **1** indicates the animal carries one copy of the favourable form of the gene.
- **2** indicates the animal carries two copies of the favourable form of the gene.

For example, **M3-2** indicates a GeneStar marbling 3 test with a result of 2 favourable forms of the gene.

Most animals listed with a gene marker result have had their DNA tested and this is described in the result line – for example: "Tested Tenderness (T1-2,T2-1)". However, some animals may have a "Derived" result because both parents have been tested and their specific results enable us to predict the gene forms of their progeny (see Predicting Progeny below). In many cases, however, it is not possible to predict the gene forms of the progeny even when both parents have been tested.

Click on the GeneSTAR logo for more information on their DNA markers and other commercial products.

Gene Markers

Breeding program design

Decide upon best strategies to reach breeding objectives:

- Decide who will become parents (selection decisions)
- Which bull to join to which cow? (mating decisions)

Total Genetic Resource Management (TGRM™):

- Tool to aid in selection and mating decisions
- Delivered via the internet (http://www.xprime.com.au/products/tgrm/)
- Maximises genetic gain while minimising inbreeding
- Constraints can be included (eg sire usage, trait levels, costs)

Other design considerations:

- Can crossbreeding be used?

Future developments

- **Inclusion of gene marker information in BREEDPLAN**
- **Multi-breed EBVs**
- **International genetic evaluations**
- **Availability of genetic benchmarking software**